Digital Multimeter

Model Q-1666

Instruction Manual

We would like to express our appreciation for your purchase of the Q-1666. This model was designed using the latest in technology to ensure high reliability.

To ensure that you get the most out of your new instrument, we recommend that you read carefully and follow the instructions in this manual.

DICK SMITH
ELECTRONICS
PTY LTD

SAFETY RULES

- Before operating this instrument, familiarize yourself with all instructions outlined in this manual.
- Always check to make sure that the function switch is set to the proper position.
- When making measurements, use CAUTION as dangerous voltages may be present in normally safe areas.
- Always disconnect the circuit under test prior to attaching test leads, as voltages may be present in capacitors even when the main power is disconnected.
- To avoid electrical shock, use CAUTION when working above 60V DC or 25V AC rms.
  Such voltages pose a shock hazard.
- Make sure all power (AC or DC) is disconnected (OFF) when making resistance (OHMS) measurements.
- Never make measurements with the battery cover OFF.
- Never fail to keep the maximum tolerable input.
- The input limitation for each function is shown below. To avoid electrical shock or damage to the DMM do not exceed the input limit.

Function	Maximum input
V(Except 400mV)	DC1200V/AC900Vrms
40mV,400mA	DC400mA/AC400mArms
10A	DC10A/AC10Arms
400mV,Ω/·))), ⊣◀	DC500V/AC500Vrms
ADP	DC250V/AC250Vrms

- Symbols

⚠ Caution symbol: Indicates the operator should refer to an explanation in this manual to prevent damage to the DMM.

ϟ Danger symbol: Indicates terminals at which dangerous voltages may exist. Take extreme care when measuring dangerous voltages to avoid shock.

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1. INTRODUCTION

This product is a high-performance digital multimeter which uses the latest in technology combined with an in-house developed A/D chip and built-in microcomputer. It features a bar graph display as well.

Compared with previously available 3.5 digit multimeters, it provides a dramatic two-fold increase in dynamic range, with a full scale display of 4000 counts, providing high accuracy and resolution rivaling that of 4 digit meters (i.e., above 2000 counts). It is an extremely valuable tool in measuring analog outputs over a wide range. In addition, a 40 segment high-speed bar graph display corresponding to the digitally displayed value enables an analog-like indication of the constant variations in measured values, a feat heretofore impossible with digital-only meters. This is extremely useful in checking varying signals and in making such adjustments as offset adjustment of analog circuitry. In addition to these capabilities, autoranging with greatly improved speed and autoranging even for current measurements are provided to automatically optimize the measurement range instantly. Basic performance has been improved and a dramatic reduction in power consumption achieved as well. A resistance range capable of measurements up to 40 MΩ, an automatic powerdown function, data hold, a memory function display illumination, electrostatic pulse protection up to 6kV, redundant protective circuitry for current ranges (except for 10A), three-terminal input and simple, dustproof construction clearly demonstrate the DICK SMITH commitment to high performance.

2. SPECIFICATIONS

2—1 General Specifications

Measuring method: Dual integration mode

Display: LCD3.5 digits max. reading of 4000 and annunciators

Bar graph display: 40 segments (100 counts resolution/ segment) with approx 23 times/sec. sampling

Range: Auto or manual ranging

Polarity: Automatic no indication for positive polarity, minus(−) sign for negative polarity.

Sampling: 2.3 times/sec.(digital display)

Over rarge indication: "OL" mark indication

Low battery indication: "🔋" mark is displayed when the battery voltage drops below operating voltage

Power down indication: The display start to flash

All segments display: When the meter is turned on, all segments are displayed

Operational temperature: 0~40℃. 80%RH max. (Non-condensing)

Storage temperature: −25~60℃,70%RH max. (Non-condensing)

Temperature coefficient: Specified accuracy × (0~18℃ & 28~40℃) 0.1/℃

Calibration: 1 year for specified accuracy

Max. common mode voltage: ±1000V or AC peak (Betweeninput terminals and outer case)

Power supply: 1.5V (AAA size, UM-4) × 2

Power consumption: Approx 2mW (TYP) (DCV mode)

Auto power down mode: The meter is powered down to 0.4mW approx. 1 hour later after the last operation was made

Battery life: 1500 hours or more (Alkaline batteries)
500hours or more (Alkaline batteries, Model Q-1666 illumination on)

Size: 80(W) × 176(H) × 37(D)mm

Weight: Approx 310g (included batteries)

Accessories: Instruction manual ························1
Safety test lead ························1 set
Batteries (1.5V, AAA size, UM-4) ······2
Spare fuse (0.5A/250V, Fast) ·········1

2—2 Measurement Ranges

Accuracy: ±(% of reading ± digit)

Ambient Temperature……23℃ ± 5℃, 80%RH Max.

⎓ DC Voltage

Range	Resolution	Accuracy	Input resistance
400mV	100μV	0.3+ 1	10MΩ
4 V	1 mV		11MΩ
40 V	10mV		10MΩ
400 V	100mV		
1000V	1 V		

Normal Mode Rejection Ratio :> 60dB at 50Hz and 60Hz

Common Mode Rejection Ratio :>120dB at DC, 50Hz and 60Hz (Rs=1kΩ)

Maximum input : 1200V DC or 900V AC rms
(400mV range only : 500V DC or AC rms)
(Transient noise protection 6kV)

Response time :1 second max. to rated accuracy within selected range

~ AC Voltage 40Hz ~ 500Hz (500Hz ~ 1kHz)

Range	Resolution	Accuracy	Input impedance
4 V	1 mV	1.0+ 2	11MΩ // <50pF
40V	10mV	1.0+ 2 (2.0+4)	10MΩ // <50pF
400V	100mV		
750V	1 V		

Conversion Type :AC coupled,average sensing,calibrated to read rms value of sinewave.

Common Mode Rejection Ratio :>60dB at 60Hz (Rs = 1k Ω)

Maximum input : 1200V DC or 900V AC rms

Response time :1 second max. to rated accuracy within selected range.

⎓ DC Current

Range	Resolution	Accuracy	Burden voltage
40mA	10 μA	1.2+ 2	<0.25V
400mA	100 μA	2.0+ 2	<2.5V
10 A	10 mA	1.5+ 2	<0.25V

Input Protection :

40/400mA Range·········500mA/250V Fast & 4A/250V Fast Fuse Protection

10A Range··············Uufused

Response time :1 second max. to rated accuracy within selected range.

~A AC Current (40Hz~1kHz)

Range	Resolution	Accuracy	Burden voltage
40mA	10 μA	2.0+ 5	<0.25V rms
400mA	100 μA		<2.5V rms
10 A	10 mA		<0.25V rms

Conversion Type : AC coupled,average sensing,calibrated to read rms value of sinewave.

Common Mode Rejection Ratio : >60dB at 60Hz

Input protection : 40/400mA Range···········500mA/250V Fast & 4A/250V Fast Fuse protection

10A Range ·············Unfused

Response time : 1 second max. to rated accuracy within selected range.

Ω Resistance

Range	Resolution	Accuracy	Test current	Open circuit voltage
400Ω	100mΩ	0.7+ 2	1.4mA	<3.3V
4 kΩ	1 Ω	0.7+ 1	80 μA	<1.3V
40kΩ	10Ω		10 μA	
400kΩ	100Ω		1.3 μA	
4 MΩ	1 kΩ		130 nA	
40MΩ	10kΩ	2.0+ 1		

Input protection : 500V rms

Response time :

400Ω~40kΩ·········1 second max. to rated accuracy within selected range.
400kΩ··············2 second —ditto—
4MΩ·················5 second —ditto—
40MΩ················10 second —ditto—

•)) Continuity Check

Range	Resolution	Continuity beeper	Test current	Open circuit voltage
400Ω	100mΩ	<40Ω	<1.4mA	<3.3V

|◀ Diode Test

Range	Resolution	Accuracy	Test Current	Open circuit Voltage	Input protection
0~ 2.000V	1mV	1.0+2	Approx 1mA (V_F=0.6V)	<3.3V	500V rms

ADP range

Range	Resolution	Accuracy	Input resistance	Input sensitivity	Input protection
0~ 4000	1	0.3+2	>10000MΩ	0.1mV/count	250V rms

3. PREPARATION AND CAUTION BEFORE MEASUREMENT

- Before making measurements, install the batteries. Two AAA size batteries can be used.
- Avoid using the D.M.M. in places subject to high temperatures, humidity or excessive vibration.
- Avoid using the D.M.M. in places with rapid temperature variations.
- If the D.M.M. is used near noise generating equipment, be aware that the display may become unstable or indicate large errors.
- If the function must be switched during a measurement, always remove the test leads from the circuit being measured. After measurement, set the power switch to "OFF".

4. OPERATION

4—1 Panel Descriptions

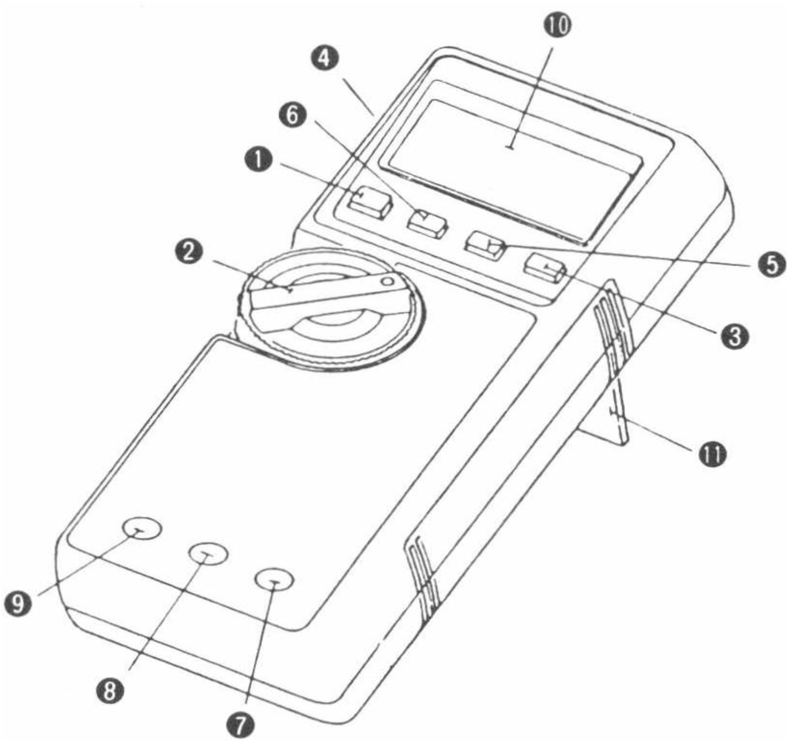


Fig.4—1 Outer view

❶ Power Switch

This locking pushbutton switch applies power to the unit when pressed in and removes it when released.

❷ Function Switch

This rotary switch selects the measurement function when aligned with function symbols on the panel.

❸ Range Switch

This switch cancels the autoranging function and enables selection of any desired range. When power is first applied, autoranging is automatically selected and the optimum range selected. For such measurements as linearity of analog circuitry, however, in which the range must be fixed, this can be overridden. Pressing the switch once changes to the manual ranging mode and locks the unit in the current range. Subsequent pressing of the switch increases the range until the uppermost range is reached, after which return is made to the lowest range and the sequence is repeated. With the range fixed, if an excessive input signal is applied, the "OL" display will appear. If this occurs, increase the range. To return the unit to the autoranging mode, hold this switch down for one second continuously. In the autoranging mode, "AUTO" will appear in the display and for each individual range, 4 , 40 or 400 will appear (with the exception of the highest voltage range). This switch is usable in all modes having autoranging and is operative for DC voltage (except for 400mV), AC voltage, DC/AC current (except for 10A) and resistance modes. The autoranging function ranges up at 4001 and above and down at 359 and below. However, if a signal is applied which causes a sudden uprange operation, 3 digit display may result. If this occurs,selecting the range with the corresponding switch will return the unit to 4 digit display.

❹ Data Hold Switch

This switch is used to hold data during a measurement.

When pressed, the current data is held and changes in input signals from that point will not change the display. This is a convenient feature when performing measurements alone. This function is operative in all measurement modes and,in the held state, D.H appears in the display. Pressing the switch once again releases the hold condition.

❺ Memory Switch

This is a newly added feature. This switch enables the storage of all displayed data (with the exception of the bar graph display). When the switch is pressed, "$\boxed{M}$" appears in the display and the current display data is stored. However, the display thereafter reflects newly input signals and measurements can continue. In this condition, the stored data is held even if the function switch setting is changed. To recall stored data, press the switch once more. Once this has been done, the "$\boxed{M}$" indicator in the display will flash indicating that stored data has been recalled. Pressing this switch once again returns to the original display mode and subsequent pressing alternates between stored data recall and the original display mode. Once data is stored,it can be cleared by holding the switch down for one second continuously (or simply by removing power), and data is held until either of these two occur. In the same manner, new data can be stored by first clearing the data and storing once again. This memory function is usable in all measurement modes and enables measured values to be recorded in memory without having to make a note of them.

❻ Illumination Switch

This switch controls the display illumination. It is effective in maintaining the readability of the display at night and in dark environments such as experienced in factories. Pressing it once turns the illumination on for approximately 30 seconds, after which it automatically goes out again. If pressed once again while the illumination is turned on, the illumination period is extended for 30 seconds beyond the second pressing. Care is required when using the function as the current consumption greatly increases when the illumination is turned on.

❼ V, Ω, mA, -|◀-, ·))) ,ADP input

This is the positive side input terminal for all functions except 10A current measurements. Connection is made here using the accessory red test lead. When using an adaptor to make connection, connection is made between this terminal and the COM ❽ terminal.

❽ COM Input Terminal

This is the negative (ground) input terminal for all measurement modes. Connection is made to it using the accessory black test lead.

❾ 10A Input Terminal

This terminal enables large current measurements up to a maximum of 10A. Connection is made to it using the accessory red test lead (this test lead enables measurerents up to 10A).

This terminal has no protective circuit and has extremely low internal resistance, so that if a large-capacity supply is accidently connected to this terminal directly, an extremely dangerous condition will exist. When making such high-current measurements, therefore, always use such protective circuitry as a 20A breaker.

⑩ Liquid Crystal Display

This liquid crystal display provides a 3.5 digit measurement data display having a maximum count of 4000, a bar graph display, as well as unit and mode annunciators. When power is first applied to the unit, all segments of the display are driven and the display appears as follows.

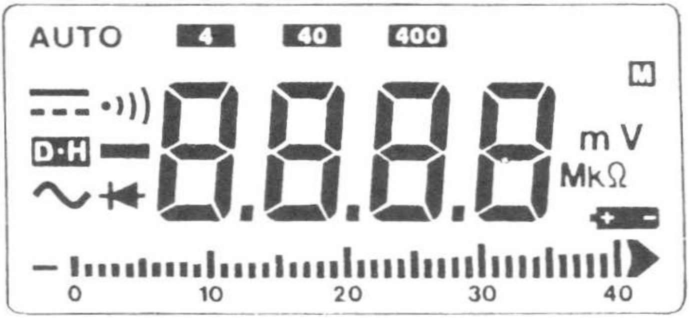


Fig.4—2

Table 4-1 Displayed Symbols and Units

Symbols/ Units	Descriptions
⎓	Indicates DC and appears for the DC voltage and current modes.
~	Indicated AC and appears for the AC current and voltage modes.
—	Polarity marks which appears when a DC signal measurement value is negative.
◀|	Appears when the diode test mode has been selected.
•)))	Appears when the continuity check mode has been selected.
D.H	Indicates that the data hold condition has been enabled.
M	Continuous: Memory contents stored. Flashing: Memory contents being displayed.
4 40 400	Range indicators which indicate the currently set range (no display for the highest voltage range).
AUTO	Appears to indicates that autoranging has been selected.
mV.V	Units for voltage measurements
Ω.kΩ.MΩ	Units for resistance measurements
+ −	Lights to indicate that battery voltage has dropped excessively.

Notes:

Units are not indicated for the current ranges.

⑪ Stand

This stand can be extended for benchtop use.

⑫ Other functions

This selection will describe functions do not appear on the panel.

● Bar Graph Display

The major feature of this multimeter is the provision of a bar graph display. This is a 40 segment display which corresponds to a full count of 4000 on the numerical display, so that one segment corresponds to 100 counts. The operating speed of this display is 10 times that of the numerical display. This enables it to quickly track fastchanging analog signals, greatly simplifying adjustment of such signals.

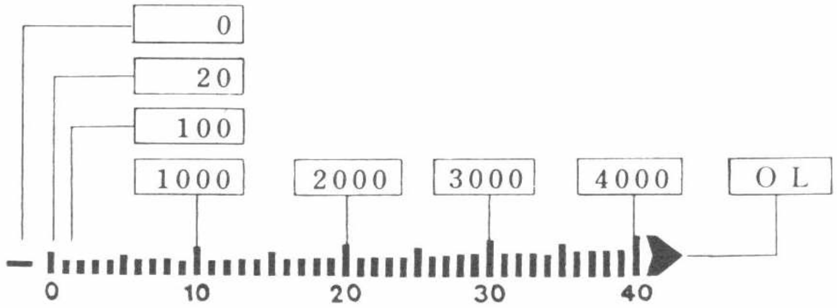


Fig.4—3 Relation of the Analog Bar Display and Numerical Display

- **Auto Power Down**

To limit power consumption, after approximately one hour has occurred since the last function or pushbutton switch operation, a 0.4 second beeper sounds and the unit goes into the power down mode. In this mode, the last data appears to flash in the display. To release the unit from this mode, press any pushbutton switch other than the power switch. When this is done, the switch will serve only to cancel the power down mode and will not have its usual function. From its second pressing,however, it is restored to its normal function. Memory contents are also saved in this power down mode.

4—2 Measurement Method

First, apply power to the unit. When this is done, a beep tone will sound and all segments on the display will appear for approximately two seconds, after which another beep tone will be heard and measurement will be possible. Next, connect the test leads to the input terminals. Connect the red lead to the V terminal and the black lead to the COM terminal. All connections with the exception of 10A measurements are made at these terminals.

(1) DC and AC Voltage Measurements

Set the function switch ❷ to " ⎓ 400mV", " ⎓

V" or "~V", depending upon whether a DC or AC voltage is to be measured and depending upon the level to be measured. If necessary, set the range using the range switch ❸. Finally, apply the test leads to the circuit to be measured. For either DC or AC measurements, connect the black test lead to the circuit ground and the red test lead to the point to be measured. Read the displayed value after the display stabilizes. The "⎓ 400mV" is an independent fixed range and autoranging is not possible from this range. If the "OL" display appears, use the "⎓ V" range to measure. Also, care is required as the "OL" display will not appear for the DC 1000V and AC 750V ranges.

(2) DC and AC Current Measurements

Set the function switch to "⎓ A" or "~A", depending upon whether DC or AC is to be measured. This applies to the 10A range as well. Next, connect the test leads in series with the circuit to be measured, connecting the red lead to the positive side and the black lead to the negative side. As is the case for the voltage measurement mode, if required, set the range switch ❸ to the desired range.

For 10A range measurements, connect the the red test lead to the 10A terminal and the black test lead to the COM terminal. When doing this, verify that the range is "$\boxed{40}$". If it was "$\boxed{400}$", set the "$\boxed{40}$" range using the range switch or set AUTO. There is no OL display with 10A range, so extreme care is required so that the 10A input limit is not exceeded.

(3) Resistance Measurement and Continuity Checks

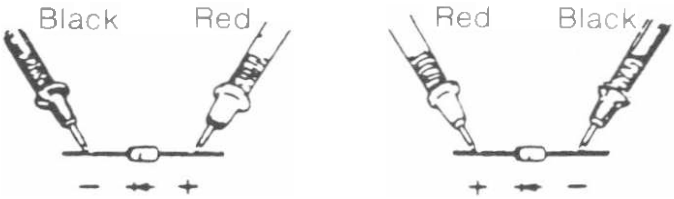
Set the function switch to both "Ω/ •)))" and, if required, set the range. Next, connect the test leads to the circuit to be measured and read the display value after the display stabilizes.

For 40MΩ ranges measurements, the accessory test leads may pick up noise from the power line and the display, therefore, may flicker. In such cases, use shielded test leads (optionally available) to stabilize the display.

To perform continuity checks, leave the unit in the resistance mode and set the range switch to "400Ω". When the resistance of the circuit being measured is less than approximately 40Ω, a beep tone will sound and the measured resistance value will be displayed.

(4) Diode Test

This function enables a check of a diodes forward voltage, deterioration in characteristics and damage. It is selected by setting the function switch to " ⊣◀ " and connecting the test leads across the diode. As shown in Fig.(a), when measuring the forward voltage across the diode, a normal diode will indicate 0.4 to 0.7V and, as shown in Fig.(b) the reverse voltage will indicate "OL" (same as an open condition). This mode enables display up to 2.2V, although care is required as the specifications are 2.0V.



(a) Forward Voltage Measurement

(b) Reverse Voltage Measurement

Fig.4—4 Diode Test Method

(5) Measurement Using Optional Accessories

A variety of optional accessories are available for this instrument. These enables, in addition to the basic functions, the measurement of temperature, large currents (using a clamp-on accessory), capacitance and transistor hFE, thus greatly expanding the measurement functions of the instrument. When using these adaptors, set the function switch to "ADP", mount the adaptor as shown in the figure below, connect the required sensor and/or circuit device to be measured and perform the measurement. At this function setting, no decimal point or units are displayed. Refer to the adaptor's instruction manual for instructions on reading the display.

In this mode, the input signal is DC only and older type adaptors (older 9300 series) are not capable of AC measurements. When using this series of adaptors, the display may read negative, in which case the polarity should be ignored and data only read.

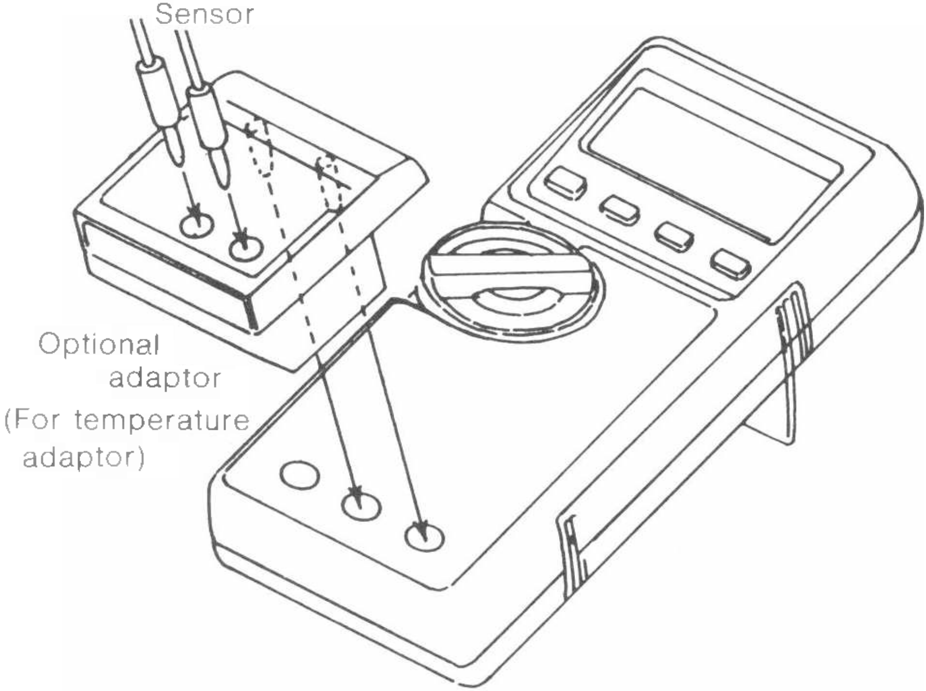


Fig.4—5 Adaptor Connection

5. BATTERY AND FUSE REPLACEMENT METHOD

Battery and fuse replacement is done by separating the top and bottom parts of the multimeter case. When opening and closing it, take care not to touch any other components and perform the replacement in a location which would not subject the instrument to dust.

5—1 Opening and Closing the Case

Use a screwdriver to loosen the screws at the four corners of the bottom of the multimeter case and carefully lift off the top part of the case. The board and bottom part of the case are connected and cannot be separated. Do not apply excessive force to these parts.

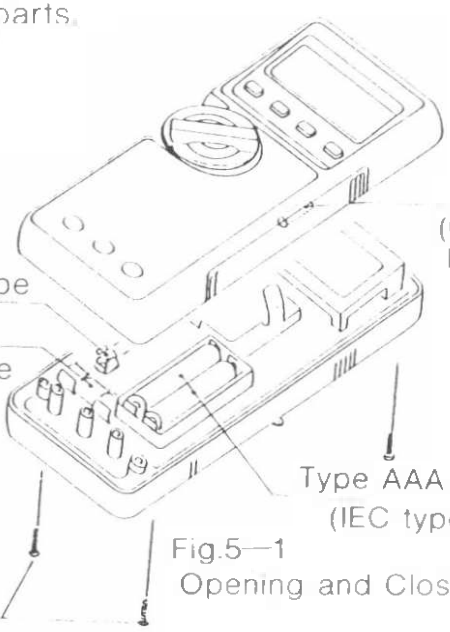


Fig.5—1
Opening and Closing the Case

5—2 Battery Replacement

While using the instrument, if the remaining battery life drops to less than approximately 20%, the warning mark "+ -" will appear in the display. Also, when using the illumination if the same warning mark appears, it is an indication that the batteries have worn down. Such cases, replace with new batteries.

Replace both batteries at one time and do not mix battery types or mix old batteries with new batteries when doing this. Be sure to insert with the correct polarity, following the marks inside the battery compartment.

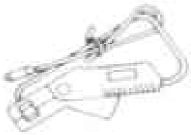
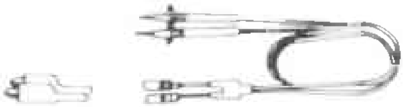
5—3 Fuse Replacement

If the protective fuse blows by virtue of an excessive current in any of the current ranges except 10A, further current measurements will not be possible. If this occurs, replace the blown fuse with a fuse of the proper rating. The 0.5A spare fuse is located inside the top part of the case. When inserting a new fuse, use a 5 dia. x 20mm, 0.5A/250V fast-blowing fuse. If the 4A fuse blows, severe damage can be suspected. If this occurs, refer to the section on service and contact your service representative. As a safety measure, never use a fuse other than one of the specified rating and never perform measurements with the case opened.

6. OPTIONAL ACCESSORIES

Optional accessories are shown in the following table.

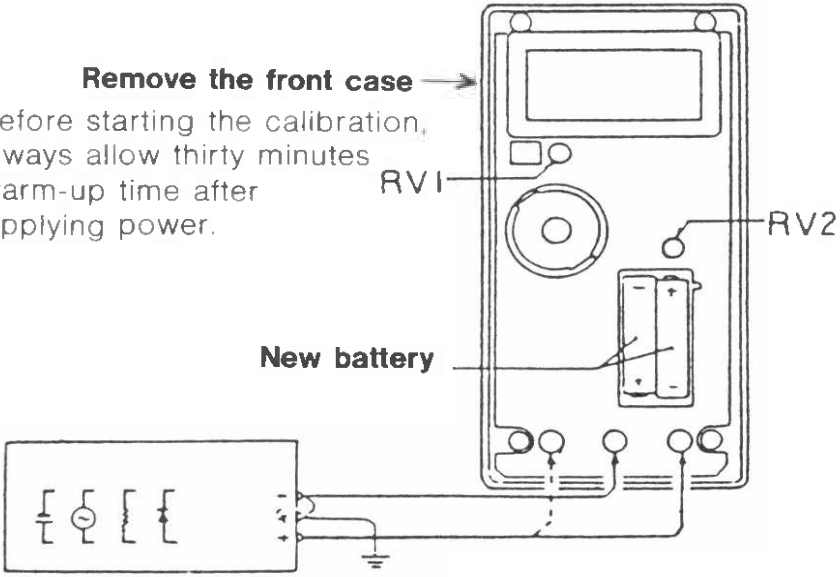
Model	Remarks
Temperature Adaptor 9310A	• Thermocouple, type "K"(CA) • −50~+700℃
Temperature Probe	Type K(CA)
TX-K10B	• −50~+300℃,JIS-class 0.4, Sheath rype.
TX-K11B	• −50~+800℃,JIS-class 0.4, Sheath type.
TX-K12B	• −50~+200℃,JIS-class 0.4, Sheath type
TX-K20B	• −20~+600℃,JIS-class 0.75, Surface. temp. measurement
TX-K21B	• −20~+200℃,JIS-class 0.75, Surface temp. measurement
Current Adaptor 9320A	• 0~200A(DC) • 0~150A(AC)

Model	Remarks
Clamp Probe 9321	• Jaw opening Capability:Approx 9mm 
Capacitance Adaptor 9330A	• 4nF～400μF(6 range) • Resolution:1pF～0.1μF
TR Adaptor 9340A	• h_{FE} 0～4000 • I_{DSS} 0～40mA
Shielded Test Lead TL-4	• Small-signal,high-resistance measurement • With alligator clips. 

Model	Remarks
10A Measuring Cable **TL—8**	- Terminated in bannana plugs and alligator clips.
Carrying Case **CC—4000**	
Protection Case **PC—4000**	

7. CALIBRATION

Fig.7—1



Before starting the calibration, always allow thirty minutes warm-up time after applying power.

Use accurate calibrator (4.5 digit or more)

(1) DC Voltage

Step	Range	Input	Adjustment	Tolerance
1	400mV	Short	—	−0.1~0.1mV
		380.00mV	RV1	378.9~381.1mV
		−380.00mV	—	−378.9~−381.1mV
2	4V	3.8000V	RV2	3.789~3.811V
3	40V	38.000V	—	37.89~38.11V
4	400V	380.00V	—	378.9~381.1V
5	1000V	1000.0V	—	997~1003V

(2) AC Voltage

Step	Range	Input	Adjustment	Tolerance
1	4V	Short	—	0~2mV
		3.8000V 100Hz	—	3.762~3.838V
2	40V	38.000V 100Hz	—	37.62~38.38V
3	400V	380.00V 100Hz	—	376.2~383.8V
4	750V	750.00V 100Hz	—	743~757V

(3) DC Current

Step	Range	Input	Adjustment	Tolerance
1	40mA	Short	—	−0.02~0.02
		38.000mA	—	37.55~38.45
2	400mA	380.00mA	—	37.24~38.76
3	10A	10.000A	—	9.85~10.15

(4) AC Current

Step	Range	Input	Ad-just-ment	Tolerance
1	40mA	Short	—	0.00~0.02
		38.000mA 100Hz	—	37.24~38.76
2	400mA	380.00mA 100Hz	—	372.4~387.6
3	10A	10.000A 100Hz	—	9.80~10.20

(5) Resistance

Step	Range	Input	Ad-just-ment	Tolerance
1	400Ω	Short	—	0.0~0.2Ω
		380.000Ω	—	377.4~382.6Ω
2	4KΩ	3.8000KΩ	—	3.774~3.826KΩ
3	40KΩ	38.000KΩ	—	37.74~38.26KΩ
4	400KΩ	380.00KΩ	—	377.4~382.6KΩ
5	4MΩ	3.8000MΩ	—	3.774~3.826MΩ
6	40MΩ	38.000MΩ	—	37.24~38.76MΩ

(6) Continuity check

Step	Range	Input	Ad-just-ment	Tolerance
1	400Ω	0~100Ω	—	40Ω or less (Beeper)

(7) Diode test

Step	Range	Input	Adjustment	Tolerance
1	0~2.000V	Open	—	"OL" mark
		Diode (forward voltage)	—	0.400~0.700V Silicon diode

(8) Adaptor range

Step	Range	Input	Adjustment	Tolerance
1	0~4000	Short	—	−2~2
		DC 380.00mV	—	3789~3811

8. MAINTENANCE

Please check the inspection items mentioned below before requesting repair.

Trouble	Cause of trouble and check point
No indication on LCD when power is turned ON	● Battery voltage has dropped ● Replace the battery according to Section 5.
Indication is unstable	● Sudden drop in battery voltage or noise-related error. ● Replace the battery according to Section 5. ● Turn off power switch and turn it on again.
Various numerals are indicated in the display even when the input is disconnected in adaptor range	● This is caused by induction noise due to the high input impedance of the D.M.M. and is not abnormal.
Measurement in current range is impossible	● Fuse is broken. ● Replace fuse according to Section 5.

When making requests for repair service, please bring the instrument directly to the dealer. If this is impossible, however, send the instrument directly to our sales office.
When mailing this instrument,always pack it in its original or equivalent packing material and pack together with name, address, telephone number and the warranty documentation.

- To ensure speedy and reliable repair, always include information as to the type of failure and cause.
- If required, always return accessories with the instrument.
- When contacting us, provide the model number and serial number of your instrument.

Dick Smith Electronics Pty Ltd.

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